REMARKS

Status of the claims

Claims 1-3 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. Patent No. 6,280,799 ("Okabe") in view of U.S. Patent No. 5,328,728 ("Swirbel"). In addition, claims 4-6 and 14-19 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Okabe in view of Swirbel, as applied to claims 1-3, and in further view of U.S. Patent No. 6,501,527 ("Hirose"). Claims 11-13 and 20 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Okabe in view of JP 11-223821 ("Minamino"). Further, claims 7-8 and 10 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. Patent Application Publication No. 2004/0125324 ("Kim") in view of Hirose. Finally, claim 9 was rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Kim in view of Hirose, as applied to claim 8, further in view of U.S. Patent No. 6,392,736 ("Furukawa").

Amendment summary

Claim 1 is amended to recite the composition of the dispersion of spacer particles, partly by incorporating the subject matter of claim 5. Support for this amendment is found, e.g., on page 21, line 35 to page 24, line 14 of the present specification.

Claim 5 is canceled.

Claim 7 has been amended for proper punctuation.

Claim 11 has been amended to recite the composition of the vinyl-based monomers. Support for this amendment is found, e.g., on page 38, line 31 to page 39, line 26 of the present specification.

Upon entry of this Amendment, claims 1-4 and 6-20 will be pending.

No new matter is added by this Amendment, and Applicant respectfully requests entry of this Amendment.

Response to rejections under 35 U.S.C. § 103 based on the combined teachings of Okabe and Swirbel

Claims 1-3 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. Patent No. 6,280,799 ("Okabe") in view of U.S. Patent No. 5,328,728 ("Swirbel"). Claims 4-6 and 14-19 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Okabe in view of Swirbel, as applied to claims 1-3, and in further view of U.S. Patent No. 6,501,527 ("Hirose").

Applicants traverse and respectfully request the Examiner to reconsider in view of the amendment to the claims and the following remarks.

As an initial matter, Applicant notes that claim 1 is amended to incorporate some of the subject matter of claim 5.

Claim 1 recites a method for manufacturing a liquid crystal display, wherein spacer particles are located at an arbitrary position on a substrate by ejecting a dispersion of spacer particles by an ink-jet method. In addition, a dispersion of spacer particles comprises a medium containing a liquid having a boiling point of less than 100°C in an amount of 10 to 80% by weight, a liquid having a boiling point of 150°C or more and 200°C or less in an amount of 80 to 10% by weight, and spacer particles. The content of the spacer particle is 0.05 to 5% by weight. Further, a diameter D_1 of an adhered droplet of the dispersion of spacer particles, having adhered to said substrate, and an outside diameter, D_2, of an area which the adhering spacer particles adhere to, remaining after said dispersion of spacer particles is evaporated, satisfies the relationship of the Equation (1): $D_2 < (D_1 \times 0.5)$.

Applicant respectfully submits that the Examiner does not appear to understand some aspects of the claimed invention, and provides the following further explanation for the Examiner's benefit.

When locating a spacer particle using an ink-jet printer and an ink-jet method, the first problem is that it is impossible to ensure that the ejected droplet is smaller than the size of the area on which spacers are to be located. Generally, the diameter of a droplet adhered to a substrate following deposition by an ink-jet method is about 40 to 200 μm.

However, as more precise, smaller, and diversified electronic equipment has been developed in recent years, higher performance has been required for liquid crystal displays, such as display downsizing and higher contrast. Therefore, the width of the shading area on which spacer particles are located has become about 10 to 30 μm. As a result, it has been very difficult to locate the spacer particle using an ink-jet printer.

Applicants respectfully direct the Examiner's attention to Figure 1 of the present application. In Figure 1, the diameter of a droplet having adhered after a droplet is ejected by an ink-jet method is larger than the width of the shading area. Thus, there are spacer particles located outside of the shading area.

The presently claimed invention addresses this issue. According to present claim 1, after the dispersion of spacer particles have adhered to the substrate, the spacer particles in the dispersion gather in the vicinity of a central portion of the droplet, adhering while the dispersion evaporates. See Figure 2 of the present application. Thus, by ejecting the dispersion of spacer particles as liquid droplets having a droplet diameter which can be formed and ejected by the recited ink-jet method, the presently claimed invention makes it possible to locate spacer particles in an area that is smaller than the area of the liquid droplet.

This technical feature of present claim 1 is achieved by using the recited dispersion of spacer particles, which comprise a medium containing a liquid having a boiling point of less than 100 °C in an amount of 10 to 80 % by weight and a liquid having a boiling point of from 150 to 200°C in an amount of 80 to 10 % by weight, and spacer particles, and wherein the content of said spacer particle is 0.05 to 5 % by weight.

Accordingly, Applicant respectfully submits that the combined teachings of Okabe and Swirbel, or Okabe, Swirbel and Hirose, do not render obvious the presently claimed invention.

Specifically, Applicant respectfully disagrees that "Okabe discloses a method for manufacturing an LCD (see figure 5, for instance) . . . satisfying a relationship of the following equation: $D_2 < (D_1 \cdot 0.5)$" (see page 2 of the Office Action of June 4, 2007). Figure 5 of Okabe is a block diagram of a viscous substance dispenser (column 12, line 19-20) that only shows ejection of the viscous substance (**11**) by the viscous substance dispenser (**12**).

In addition, the Office Action indicates a position that column 6, lines 42-46 discloses diameter D_1 of an adhered droplet. However, column 6, lines 42-46 only refers to a comparison between the diameter of the orifice (r_1) and the diameter of the dot of the viscous substance **11**(r_2). With respect to diameter D_2 of the adhering spacer particles, Applicant respectfully submits that column 6, lines 55-58 of Okabe, cited in the Office Action as teaching this aspect of the present invention, refers only to the comparison between the diameter of the orifice (r_1) and the particle size(r_3). Accordingly, Okabe does not render obvious the presently recited D_1, which is a diameter of an adhered droplet of dispersion of spacer particles having adhered to substrate, and D_2, which is an outside diameter of an area in which the adhering spacer particles remain after the dispersion of spacer particles (the presently recited D_2 is not the equivalent of the r_1 or r_3 of Okabe).

Applicant further respectfully submits that Okabe does not render obvious the presently claimed invention, either alone or when combined with the teachings of Hirose and/or Swirbel, because the presently claimed invention relates to the adhered droplet of a dispersion of spacer particles after being ejected by an ink-jet method. On the other hand, Okabe relates only to the viscous substance as it is present before being ejected by the dispenser.

In addition, Applicant further respectfully submits that the Examiner has not set forth a proper *prima facie* case of obviousness because, as discussed above, present claim 1 relates to locating spacer particles in an area that is smaller than the area of the liquid droplet. However, neither Okabe nor Swirbel disclose or teach how to locate spacer particles in an area smaller than the area of the liquid droplet by using the dispersion of spacer particles described in present claim 1. Specifically of note, Okabe discloses an organic or inorganic liquid for the viscous substance (see column 7, line 59 to column 8, line 53 of Okabe). However, Okabe does not disclose the combination, nor the ratio, of the liquids therein.

Finally, Applicant respectfully submits that the compositions disclosed in Examples 1-3 of Swirbel do not render obvious the presently claimed invention because the compositions therein are not suitable for the presently claimed invention.

In view of the above, Applicant respectfully requests the reconsideration and withdrawal of the §103 rejections of claims 1-6 and 14-19 based on Okabe, Swirbel and Hirose.

Response to rejection of Claims 11-13 and 20 under 35 U.S.C. § 103(a) based on Okabe in view of Minamino

Claims 11-13 and 20 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Okabe in view of JP 11-223821 ("Minamino").

Present independent claim 11 recites a dispersion of spacer particles, which comprises spacer particles in which a vinyl-based thermoplastic resin, formed by free radical polymerizing a mixture of vinyl-based monomers comprising a vinyl-based monomer having a hydrophilic functional group in an amount of 30 to 80% by weight and a vinyl-based monomer having an alkyl group having 3 to 22 carbon atoms in an amount of 20 to 60% by weight, is combined with the surface of an inorganic fine particle and/or an organic fine particle by graft polymerization. The dispersion also includes a medium comprising water and/or a hydrophilic organic solvent and having the surface tension of 25 to 50 mN/m at 20°C, and the spacer particles are dispersed in the form of individual particles in said medium.

Again, Applicant respectfully submits that the Examiner appears not to have fully appreciated the invention of claim 11, and provides the following explanation for the Examiner's ease of reference.

In a piezo ink-jet system that may be suitably used for ejecting a dispersion of spacer particles in several kinds of ink-jet systems, it is known in the art that the surface tension of the ejected liquid is preferably from 25 to 55 mN/m. The dispersibility of the spacer particles in the dispersion is influenced by the hydrophilicity or hydrophobicity of the surface of the spacer particle. For a stable dispersal in the dispersion of spacer particles, a hydrophilic surface is more preferable; hydrophilic spacer particles also have good affinities for the orientation layer on the substrate. On the other hand, it is also necessary to prevent light leakage, which may be due to

the abnormal orientation of liquid crystals around spacer particles which have overrun the pixels. The introduction of a hydrophobic functional group on the surface of the spacer particle, while known to effectively control the abnormal orientation of liquid crystals, also promotes the conglomeration of spacer particles, such that the spacer particles are not present as single particles in the medium for ink-jet ink.

As can be seen, the properties required for a spacer particle are very complicated, and it has been difficult to satisfy all of the above requirements while also maintaining excellent dispersibility.

To this end, present claim 11 recites a spacer particle formed by free radical polymerizing a mixture of vinyl-based monomers containing a vinyl-based monomer having a hydrophilic functional group in an amount of 30 to 80% by weight and a vinyl-based monomer having an alkyl group having 3 to 22 carbon atoms in an amount of 20 to 60% by weight. As noted on, e.g., page 39 of the present specification, when the content of the vinyl-based monomer having the hydrophilic functional group is less than 30% by weight, it becomes difficult to disperse the obtained spacer particle sufficiently in the form of single particles in a medium of the dispersion. Cohesion spacers therefore become apt to arise, such that stable ejection in an ink-jet system or formation of accurate cell gaps may become difficult. When the amount is more than 80% by weight, abnormal orientation of liquid crystal may become apt to occur on the surface of spacers which have overrun into display pixels in the forming of a cell of a liquid crystal display, leading to a reduction in display quality.

When the content of the vinyl-based monomer having the above alkyl group having 3 to 22 carbon atoms in the vinyl-based monomer is less than 20% by weight, abnormal orientation of the liquid crystal may become apt to occur on the surface of spacer particles which have overrun

into display pixels in the forming of a cell of a liquid crystal display, leading to a reduction in display quality. When the amount is more than 60% by weight, the dispersion stability of the resulting spacer particles in a medium may be reduced.

Accordingly, Applicant respectfully submits that the combined teachings of Okabe and Minamino do not render obvious the presently claimed invention.

Specifically, Applicant respectfully disagrees with the position set forth in the Office Action that Okabe discloses in column 7, lines 62-67 the graft polymerization of the presently recited polymer onto an inorganic or organic fine particle. Rather, this passage in Okabe merely asserts that the viscous substance therein contains an organic or inorganic liquid as a principal component, and a pattern forming material (objective substance) dissolved or dispersed in the organic or inorganic liquid. Applicant respectfully submits that this does not render obvious the presently claimed invention and does not disclose the graft polymerization relied upon in the Office Action.

In addition, Applicant respectfully submits that Okabe does not disclose the presently recited polymer. With reference to column 9, lines 24-63 of Okabe, cited in the Office Action for its alleged teaching of the presently recited monomer, Applicant notes that this passage in Okabe only discloses the presence of a binder and gives broad examples that would not lead a person of ordinary skill in the art to the presently claimed invention.

Applicant also respectfully notes that Okabe does not disclose the surface tension of the present claims. Column 8, line 14 of Okabe, which, according to the Office Action, teaches this aspect of the present invention, only describes the electric conductivity of the material in Okabe. Electric conductivity does not correspond to the presently recited surface tension. Accordingly,

Applicant respectfully submits that Okabe does not disclose or teach the surface tension of the present claims.

Okabe also does not teach the spacer particles being present in the form of single particles in a medium, as recited by the present claims. Although the Office Action alleges that column 7, line 65 of Okabe teaches this aspect of the invention, this passage in Okabe does not teach or suggest spacer particles dispersed in the form of single particles in a medium.

Finally, Applicant respectfully submits that Minamino does not remedy the deficiencies of Okabe, set forth above. Okabe in view of Minamino, therefore, does not render obvious the presently claimed invention. Accordingly, Applicant respectfully requests the reconsideration and withdrawal of this § 103 rejection.

Response to rejections based on Kim

Claims 7-8 and 10 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Kim in view of Hirose. Claim 9 was rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Kim in view of Hirose, as applied to claim 8, further in view of Furukawa.

Applicant submits herewith a verified English translation of priority document JP 2002-179970 (JP '970), filed on June 20, 2002, which contains support for present claims 7-10, as shown, e.g., in the table below:

Claim	Support in JP '970
7	Paragraph Nos. [0020] and [0024]
8	Paragraph No. [0021]
9	Paragraph No. [0022]
10	Paragraph Nos. [0021], [0033], and [0034]

Accordingly, Kim, which has a U.S. filing date of December 27, 2002, does not constitute prior art. Applicant therefore respectfully requests the withdrawal of the rejections based on Kim.

Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

Joseph J. Ruch, Jr.
Registration No. 26,577

SUGHRUE MION, PLLC
Telephone: (202) 293-7060

Facsimile: (202) 293-7860

WASHINGTON OFFICE
23373
CUSTOMER NUMBER

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